Ch 10 Work, Energy, and Machines

10.1 Work and Energy

I. Work

A. By manipulating $v_f^2 = v_i^2 + 2ad$ and substituting $a = (\text{Force}/\text{mass})$, you get

$$Fd = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

1. left side of equation describes action done to a system by external world

B. When a force is applied through a displacement work is done

1. SI unit for work is a Joule (J) which measures energy

C. Work done by constant force

1. Work = force · distance or $W = F \cdot d$
2. Constant force at angle
   a. Work = force · distance · $\cos\theta$
   b. when constant forces are perpindicular to displacement (90°), no work is done → 0

D. Work done by many forces

1. When several forces are exerted on a system, calculate the work done by each force, then add results
   → Figure 3 (p. 648)

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E. Finding work done when forces change

1. A graph of force versus displacement lets you determine the work done by a force
   → See figure 4 (p. 649)

II Energy (E) - the ability of a stystem to cause change to itself or its surroundings

A. Right side of $Fd = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ indicates in energy

B. This is represented in the work-energy theorem

a. Work = ΔE

C. Through the process of work, energy can move between the external world and a system

D. Energy associated with motion = Kinetic energy

E. Energy due to changing position = translational kinetic energy

1. Equation → $KE_{trans} = \frac{1}{2}mv^2$

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III Power - the rate at which energy is transferred

A. Equation → $P = \frac{\Delta E}{T}$

1. When work causes change in energy the equation becomes $P = \frac{W}{t}$

2. Power is measured in watts, 1 J of energy tranformed in one second

B. Power and Speed

1. When force (F_x) is in same direction as displacement $P = F \cdot v \rightarrow P = F \cdot v$

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10.1 Review

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1 The work-energy theorem states that when work is done on an object, the result is a change in _____.

B potential energy
C power
D work-energy

A kinetic energy

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2 Power is measured in _____.

A joules
B ohms
C kilo-joules

D watts

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3 How much work is done in pushing a tall box 15m with a force of 400 N, that is applied slightly upward at an angle of 10 degrees from horizontal (answer in J)?

$W = f \cdot d \cdot \cos\theta$

$\approx 5900\,J$

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4 A net force, the magnitude of which is 2800 N, acclerates at 1250-kg vehicle for 8.0 s. The vehicle travels 80.0 m during this time. What power output does this represent (answer in kW)?

$P = \frac{W}{t} \rightarrow W = f \cdot d$

$W = 2800 \cdot 80 = \frac{224000\,J}{8}$

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5 Jose lifts a 20 kg block to a height of 2.0 m in 5.0 s. Sue lifts 30 kg to a height of 1.5 m in 8.0 s. Which student has more power?

Jose $\frac{20 \cdot (9.8)}{F} \cdot 2m = \frac{400N}{5} = 80J$

Sue $30 \cdot (9.8) \cdot 1.5m = \frac{450N}{8} = 56.2J$

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